Delaware Department of Transportation
Division of Transportation Solutions
Design Guidance Memorandum

Memorandum Number 1-18

1. Road Design Manual 2. Bridge Design Manual 3. Utilities Design Manual
4. Real Estate Manual 5. Standard Specifications 6. Standard Construction Details

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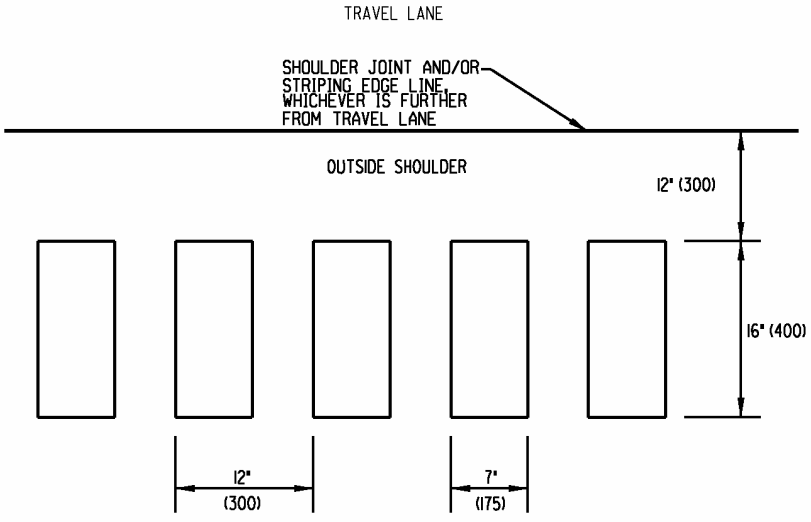
Title: Continuous Centerline and Longitudinal Edgeline Rumble Strips Effective date: 4/9/2007

Sections to Implement:

X Project Development	X Planning	___ DTC
X Bridge	X Quality	X Traffic
X Team Support	X Maintenance &	___ Other _____
X Utilities	Operations	

I. Purpose

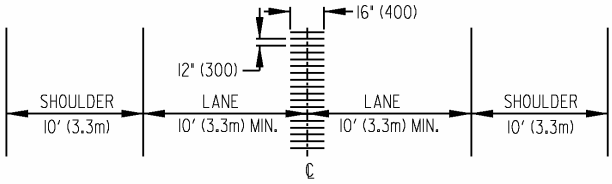
To define when and where continuous longitudinal rumble strips may be applied on the state highway system. (See Figures 1 through 3.) Additional guidance can be found in Technical Advisory T5040.35 of the Federal Highway Administration (FHWA); please see the site http://www.fhwa.dot.gov/legsregs/directives/techadvs/t504035.htm. References to the practices of other states may be found at http://safety.fhwa.dot.gov/roadway_dept/rumble/index.htm. Information concerning a centerline rumblestrip project within the State of Delaware may be found at http://www.deldot.gov/static/projects/rumblestrip/.



PLAN

FIGURE 1
EDGELINE RUMBLE STRIP DETAILS
N.T.S

1) RUMBLE STRIPS SHALL BE INSTALLED IN ACCORDANCE WITH ITEM 760504 - RUMBLE STRIPS.
2) RUMBLE STRIPS SHALL BE PLACED ON SHOULDERS IN LOCATIONS SHOWN ON THE PLANS OR AS DIRECTED BY ENGINEER.



PLAN

FIGURE 2
CENTERLINE RUMBLE STRIP DETAILS
N.T.S

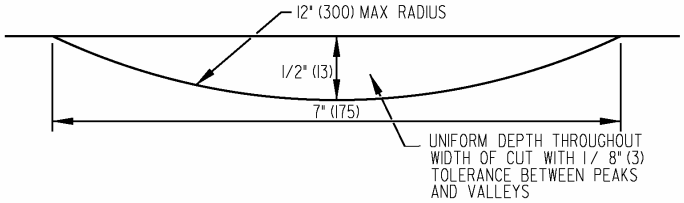


FIGURE 3
RUMBLE STRIP SECTION
N.T.S

II. Design Guidance

The purpose of centerline or continuous longitudinal rumble strips is to enhance safety by preventing crossover or run-off-road (ROR) collisions from occurring. Rumble strips are intended to alert drivers by creating an audible (noise) and tactile (rumble or vibratory) warning sensation that the vehicle is leaving the traveled way (traffic lane) and that a steering correction is required. Before and after accident studies have indicated that both crossover and ROR type crashes may be reduced significantly by the use of rumble strips.

The intent of the rumble strip is to gain the attention of a driver. Naturally, the byproduct of this measure is noise. In isolated areas this is usually not a problem. However; when installed in a suburban or urban area, the noise from rumble strips may be quite disruptive to nearby residents. The noise issues should not be underestimated or dismissed easily and it is highly recommended to weigh the noise implications of rumble strips if they are going to be located in populated areas. If there is any concern that noise could be an issue, Engineering Support should be consulted.

Continuous longitudinal milled rumble strips should be applied to the mainline roadway on projects per the following recommendations.

1. Edgeline rumble strips should be installed on new, reconstructed and resurfaced shoulders (inside and outside shoulders) of all full and limited access highways regardless of crash history.
2. Edgeline rumble strips should be considered on all two-lane roadways with a minimum of 11 foot lanes, 4 foot shoulders and 1,800 ADT. An engineering study shall be conducted

to determine if ROR crash rates along the section of roadway exceed statewide or national averages for similarly classified roadways and if rumble strips are a viable crash reduction countermeasure. The study should be reviewed and approved by the Chief Traffic Engineer.

3. Rumble strips should be considered on all divided highways with installation on both the inside and outside shoulders. An engineering study shall be conducted to determine if ROR and/or crossover crash rates along the section of roadway exceed statewide or national averages for similarly classified roadways and if rumble strips are a viable crash reduction countermeasure. The study should be reviewed and approved by the Traffic Section.
4. Centerline rumble strips should be considered on all highways where an engineering study shows that crossover crash rates along the section of roadway exceed statewide or national averages for similarly classified roadways and if rumble strips are a viable crash reduction countermeasure. The study should be reviewed and approved by the Chief Traffic Engineer.
5. If appreciable bicycle traffic exists or is anticipated, then a minimum effective clear shoulder width of 4 feet should be provided from the outside edge of the rumble strip groove to the outside edge of the paved shoulder, or 5 feet from the outside edge of the rumble strip groove to the front face of barrier (including curb) or guardrail. If this clear area cannot be maintained then a change of configuration and/or deletion of the rumble strip should be considered. Rumble strips should be discontinued 50 feet before and after adjacent guardrail where there is less than 4 feet between the outside edge of the rumble strip and the face of the guardrail.
6. Ten foot gaps for bicyclists to traverse the rumble strip treatment should be provided, especially in areas where bicyclists make turns or cross the road. For such situations, the rumble strip pattern should consist of 30-foot long segments of rumble strips with 10-foot segments of no rumble strips.
7. Rumble strips are to be broken for all intersections, and driveway entrances where the shoulder edgeline pavement markings tie into the driveway entrance. The installation of rumble strips should be stopped 25 feet prior to the turn radius PC and restarted 25 feet after the turn radius PT.
8. Rumble strips should not be installed on bridge decks, overpasses or roadways with structural reinforcement.
9. Rumble strips should not be installed on acceleration or deceleration lanes. Installation should stop 150 feet prior to the diverge point of a deceleration lane and should not commence until 150 feet downstream of the merge point for an acceleration lane.
10. Centerline rumble strips should start and end following the centerline striping. In areas where the centerline leads into a raised concrete island, the rumble strips should be discontinued within the limits these islands. In areas where the centerline splits to create, for example, a turn lane the rumble strips should be placed along both portions of the centerline.
11. Generally, continuous longitudinal rumble strips should not be applied on the shoulders of roadways within developed and urban areas. In suburban and developing areas, the designer should consult with Engineering Support to determine if noise will be a concern.

12. The make-up of the new pavement or the thickness, condition, and type of existing pavement needs to be determined prior to the application of ground-in rumble strip. The installation of ground-in rumble strip on pavement that is of questionable thickness, condition, or type (e.g. hot-mix over P.C.C. pavement) needs to be evaluated to ensure that the installation of the rumble strip will be possible without adverse impact to the pavement or the performance of the strip. It is recommended that the Pavement Design Engineer and the Pavement Management Engineer be consulted prior to recommending rumble strip installation on any shoulder.

This guidance and the figures herein do not account for all possible applications (e.g. rural gore areas). Therefore, it may be necessary for the designer to develop special application plans or details for the application of ground-in or alternative longitudinal rumble strip treatments. All such plans and details should be submitted to the Chief Traffic Engineer for review prior to their use on a project. This includes the use of centerline rumble strip on two-way highways where additional factors such as lane width, total roadway width etc. should be considered.

III. Justification

To improve safety by alerting inattentive drivers through vibration and sound with continuous longitudinal centerline and/or edgeline rumble strips that their vehicles have left the travel lane. An FHWA Delaware Division Office study revealed that in 2003 the benefit/cost ratio of the rumble strips installed on I-95 south of Wilmington in 1998 was approximately 7:1. The unit costs for the rumble strips on this project were $7.92 per foot. The price of rumble strips has dropped significantly since this installation; in 2003 DelDOT paid 24 cents per foot for the installation of rumble strips along SR 1. If this had been the unit price for the I-95 project, the benefit/cost ratio would have been 212:1. A benefit to cost ratio for an installation of centerline rumble strips along US 301 was determined to be 110.

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Recommended by: Assistant Director – Design Date

4/4/07
Approved: Chief Engineer Date

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